Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov / Dec – 2019**

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| **Code :** | **17PH3011** | **Duration :** | **3hrs** |
| **Sub. Name :** | **NUCLEAR AND PARTICLE PHYSICS** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Using Woods Saxon function, describe the structure of nucleus and explain how the nucleus system acts a quantum mechanical system and how it is not a rigid system with fixed radius. | CO1 | 16 |
| b. | Describe the significant failures of liquid drop model of nucleus. | CO1 | 4 |
| (OR) | | | | |
| 2. | a. | Demonstrate with suitable examples the existence of magic numbered nuclei in nature. | CO1 | 16 |
| b. | Deduce the binding energy (total) of an uranium nucleus (). Given that av = 15.5 MeV, as = 16.8 MeV, ac = 0.72 MeV, asym = 23 MeV, ap = 34 MeV. | CO1 | 4 |
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| 3. | a. | Nuclear force is charge independent even though it is made up of charged particles like proton and neutral particles like neutron. Prove the above statement by applying appropriate theory and valid set of equations. | CO2 | 16 |
|  | b. | Compare and contrast the various types of radionuclitide decay modes. Apart from the well known three decay modes namely, alpha particle radiation, beta particle radiation and gamma rays, there are 6 more known radioactive decay modes which occur rarely. List out these rare decay modes. | CO2 | 4 |
| (OR) | | | | |
| 4. | a. | Apply semi-empirical mass formula to the problem of neutron star in space where trillions and trillions of neutrons exist inside a single system whereas the same is not possible on the surface of planet earth even if a nucleus is consisting of two neutrons. | CO2 | 16 |
|  | b. | The number of known nuclei naturally occurring is about 300. They start with a mass number of 1 (hydrogen nuclei) to a mass number of 238 (uranium nuclei). Calculate the radius range of these entire set of nuclei. | CO2 | 4 |
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| 5. | a. | Evaluate the alpha particle nuclear process with the help of Gamow’s theory of alpha decay. | CO3 | 16 |
|  | b. | Define the process of energy release during electron capture phenomenon. | CO3 | 4 |
| (OR) | | | | |
| 6. | a. | Summarize in detail the multiple ways in which beta particles interact with surrounding matter. | CO3 | 16 |
|  | b. | Identify isotope, isobar and isotone from the given sets out nuclei.  ( , )  ( , )  ( , ) | CO3 | 4 |
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| 7. | a. | Distinguish in detail between direct reactions, strip-up reactions and pick-up reactions. | CO4 | 16 |
|  | b. | Given that the wave function of the neutron beam in neutron proton scattering is given by after the interaction. Find the value of the constant ‘k’ if the energy of the incoming neutron beam is around 10 MeV and the depth of the potential well of the scattering center is 36 MeV. Assume the reduced mass of the system is given by m = 0.835 x 10-27 kg. | CO4 | 4 |
| (OR) | | | | |
| 8. | a. | Dr.Homi Jehangir Bhabha after a careful scrutiny of available nuclear ores in Indian peninsula envisaged a three stage programme for India. Explain in detail. | CO4 | 16 |
|  | b. | Moderator and coolant are important components of a nuclear reactor. Describe the same for the following nuclear reactors.  Pressurized Heavy Water Reactor  Fast Breeder Reactor  Advanced Light Water Reactor  Boiling Water Reactor  Advanced Heavy Water Reactor | CO4 | 4 |
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| **Compulsory**: | | |  |  |
| 9. | a. | According to the spin of the particles and whether they obey Pauli’s exclusion principle or not, fundamental particles are classified into two. Elucidate the classification scheme in detail. | CO5 | 16 |
|  | b. | Elaborate on the importance of Higg’s boson in understanding the mass of fundamental particles. | CO5 | 4 |